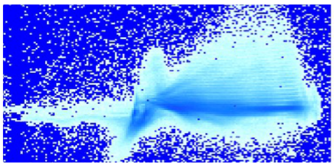

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Coupling X-ray photon correlation spectroscopy and dynamic coherent X-ray diffraction imaging using triangular aperture

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Coherent X-ray diffraction imaging (CXDI) is a powerful method for visualizing the structure of an object with a high spatial resolution that exceeds the performance of the lens. CXDI is of several types, based on the optical systems and reconstruction methods. Plane-wave CXDI, in which a coherent planar beam is incident on a sample, can be used to observe isolated objects. Nonetheless, scanning CXDI, commonly known as ptychographic CXDI, is superior because it enables the observation of extended samples; however, its disadvantage is that improving its temporal resolution is challenging as it is based on multiframe data collection. Therefore, a method for reconstructing the image of an extended object using a single-frame diffraction intensity pattern must be established.

Previously, we proposed and demonstrated a practical method for single-frame CXDI in the hard X-ray regime [1, 2], in which a triangular aperture is used as a critical element in the optical system. The phase image of a selected field of view of an extended object was reconstructed from the single-frame diffraction intensity pattern based on a phase retrieval calculation. Furthermore, recently, we also proposed and demonstrated an approach to analyze particle motion in heterogeneous solutions over a wide spatiotemporal scale by combining XPCS and single-frame CXDI using triangular aperture [3]. By applying this approach to analyze of the dynamics of colloidal gold nanoparticles dispersed in aqueous polyvinyl alcohol solutions, we found that Brownian motion exists in the range of a few hundred nanometers, and two modes of motion exist in the micrometer range. In this presentation, the details of the CXDI method and the experimental results are presented.

References

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